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Nov. 13	71°·2	57°·3
14	75·2	59·6
15	72·7	55·0
16	61·0	50·0

On the Luminous Meteors of November 13–14, 1866.
By Professor Challis.

The extraordinary display of meteors on November 13, was observed by me at the Cambridge Observatory in conjunction with Professor Adams and his assistants Mr. Graham and Mr. Todd. Intending to devote myself principally to the determination of apparent positions, I had prepared a small wooden instrument, which I call a "meteoroscope," which was fixed to a tripod stand, and was furnished with a straight bar for pointing, 21 inches long, and readily movable in altitude and azimuth. The movements of the bar were read off by indices from a vertical arc and a horizontal circle, which I graduated for the occasion to integral degrees. The observers were all situated on the flat roof of a detached out-building, which commanded the whole of the heavens except a small portion southward, which was intercepted by the Observatory building. As there were two meteoroscopes in use, it was agreed to divide the heavens into northern and southern halves, and as I took the northern half, my observations were generally restricted to that portion, excepting when it was covered by cloud. At the first sight of each meteor whose position I observed, I called out "Now," and Mr. Todd gave out the time, having before him a mean time chronometer, which served for the observations with both meteoroscopes. I then pointed the bar to the estimated place of the meteor, read off the altitude and azimuth angles, and mentioned the magnitude, direction of flight, and incidental physical circumstances. These data, with the time, were recorded by H. Wilberforce Clarke, Esq., R.E., of Chatham, who kindly volunteered to assist on the occasion. In this manner I obtained 63 positions of meteors, with 7 positions of stars, the latter being taken in order to serve for correcting for error of position of the axis of the instrument, which did not admit of being adjusted vertically by a spirit-level. The true altitudes and azimuths of the meteors have been calculated from the recorded angles with as much exactness as the rude nature of the observations allowed of, and, together with the Greenwich mean times, have been communicated to Mr. Glaisher, in the hope that by comparison with observations made elsewhere they might be used for determining the actual courses of the

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meteors and their heights above the Earth's surface. The observations were all made between $11\frac{1}{2}^h$ and $14\frac{1}{4}^h$. Many more might have been taken in the same time; but the meteors gradually became so numerous that I relaxed my efforts to get positions on account of the improbability that the same meteor would be observed at different localities. Also about 13^h clouds rose up from the north-west, and shortly covered the heavens, which continued clouded for about 20^m. I succeeded, however, in obtaining at $13^h\ 20^m$ the following observation, from which I have deduced a determination of the position of the Radiant Point.

At the time mentioned, which was noted roughly by means of my watch, regular observations not having recommenced, I saw a meteor which for an instant was stationary, and quickly after another at the same altitude and a little more northward, but smaller than the first, and perhaps not quite so stationary. I then pointed the meteoroscope to an estimated position, somewhere between the two meteors, and gave the altitude and azimuth readings. Immediately after I took with the meteoroscope the position of *Regulus*. I then mapped down on a piece of paper six neighbouring stars, *Regulus* included, together with the estimated position of the radiant point. By reference to Johnston's Star-map, allowance being made for the annual variations since the date of the map (1850), I obtained for the position of the point, R.A. $= 148^\circ\ 59'$, Decl. $= +22^\circ\ 47'$. The observation with the meteoroscope being reduced in the same manner as the other observations of meteors, gave for the azimuth from N. towards E., $83^\circ\ 44'$, and for altitude, $25^\circ\ 12'$; whence by calculation R.A. $= 150^\circ\ 58'$, and Decl. $= +23^\circ\ 36'$. This result does not agree with the other, owing perhaps in part to error in the noted time of the observation. As such an error would affect the determination of R.A. in greater degree than that of Decl., I propose to give double weight to the value of the R.A. derived from the map, and equal weights to the two values of the Declination. Thus, the concluded position of the Radiant Point will be, R.A. $= 149^\circ\ 39'$, Decl. $= +23^\circ\ 12'$.

Being chiefly occupied with taking observations of position and direction of flight, I did not note the lengths of course and the times they occupied, although, as it now appears to me, this class of observations is of great importance with respect to the theory of the phenomena. The following are the principal physical circumstances that I remarked. The meteors began to make their appearance at $11\frac{1}{4}^h$; from $11\frac{1}{2}^h$ to 13^h the number continually increased, attaining a maximum probably about $13\frac{1}{4}^h$ for the northern half of the heavens. At 14^h I noted that the number had much declined, and at $14\frac{1}{4}^h$ when I left off observing, the rate might be about one each minute. Almost all of them had trains, the majority of which lasted from one to three seconds, a few remaining much

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longer. The magnitudes ranged for the most part between that of *Venus* at her brightest and a star of the second magnitude, those of inferior brightness being the exception. The apparent directions were remarkably conformable to the hypothesis of radiation from a fixed point of the heavens, that is, of a fixed direction relative to the Earth supposed to have no motion of translation. In these three particulars this November set of meteors presented a marked contrast to those I have frequently observed at the August period, in which a large majority were extremely small, trains were the exception rather than the rule, and a large number deviated considerably from an exact law of radiation. Another circumstance which also I had not noticed at the August period, was a blue or green appearance of several of the trains, with heads of a ruddy colour. Some few of the heads also were thought to be blue. I remarked that during a great part of the time over which the observations extended, there was a kind of *glow* throughout the heavens, a phenomenon which I was familiar with by my previous experience at the Cambridge Observatory, and which my assistants also noticed, and were accustomed to call "Auroral Light." It was, however, never accompanied by auroral streamers. Mr. Glaisher has informed me that the magnets at Greenwich were remarkably quiet during the night of November 13.

Cambridge, January 4, 1867.

On the Spectra of the Meteors of Nov. 13–14, 1866.

By John Browning, Esq.

To view the shower I chose the Observatory of Mr. H. Barnes, at Upper Holloway. The situation was good, the Observatory being built on high ground, and so placed that the Radiant Point rose in the contrary direction to the lights of London.

I devoted my attention exclusively to attempting to obtain the spectra of as many meteors as possible.

After catching a few spectra in different directions, I at length decided on keeping the direct-vision prism pointed a little to the west of *Leo Major*, with the axis of the prism parallel to the horizon. The spectra which I saw were those of meteors which started from the Radiant Point and passed through the belt of *Orion*. Of course the number of meteors which came into my field was comparatively limited, but the whole of them travelled in a direction parallel to the axis of the prism, a condition essential in the observation of the spectra.

From the rapid flight of the meteors rendering the spectra